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Abstract

DETERMINATION OF TRACE ELEMENTS IN THE GREEK LAKES BY NEUTRON ACTIVATION ANALYSIS

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Nuclear reactors are prolific sources of neutrons for producing (n,γ) reactions. Using the Democritus Reactor it has been possible to apply neutron activation analysis for the determination of 14 elements in the waters of the 11 most important lakes of Greece.

The purpose of this study was to determine and compare the stable elements present in microgram and submicrogram quantities in each Lake. Therefore: a) to broaden and extend our knowledge of the abundance of trace elements present in Lakes, b) to find out the geological importance of the elements investigated, c) to extend this study in Lake organisms and have information concerning the biological effect of them.

Samples analyzed were collected from the surface and 5 or 15 meters depth at the deepest point of each Lake throughout Greece. The collection of samples was made from July 16 to August 14, in 1963. The 14 elements investigated were: silver, gold, arsenic, barium, bromine, chlorine, copper, iodine, potassium, manganese, sodium, rhenium, vanadium and zinc.

A quantitative analysis of the above elements present in the samples was accomplished by irradiating a standard with the unknown sample. The comparison of their induced radioactivity was made by gamma scintillation spectrometry. For irradiations up to 30 minutes, the pneumatic facility of our laboratory was used. Such irradiations

were made for silver, vanadium, copper, chlorine, iodine, sodium and manganese. For the rest of the elements, an 8-hour irradiation period was chosen. The neutron flux of the Democritus Reactor was 2×10^{11} neutrons per square centimeter per second.

Non destructive activation analysis was used for silver, chlorine and sodium. The induced activity of silver-110, chlorine-38 and sodium-24 was measured directly on a 3x3 in. thallium activated sodium iodide crystal of a 400 channel analyser.

Rapid radiochemical separations based on solvent extraction techniques were performed for arsenic, copper, gold, rhenium, vanadium and zinc. After irradiation the radioelements produced, together with their respective carriers added were extracted as follows: arsenic as arsenic bromide into benzene from 6.5M sulphuric acid solutions. Vanadium and copper as cupferrates into chloroform from 1.2M hydrochloric acid solutions. Zinc and rhenium as chlorides into 70% n-tributyphosphate in benzene from 4M hydrochloric acid solutions and gold as chloride into ethylacetate from 6M hydrochloric acid solutions. The radioelements together with their carriers were back extracted into the aqueous phase, precipitated with the proper reagents and measured by gamma spectrometry. The whole analysis ranged from 5 min. to 20 min. depending on the element.

For the rest of the elements decontamination steps based on precipitation techniques were performed.

The abundance of the trace elements determined in the Lakes varied according to the element and the Lake. The quantities of chlorine and sodium found ranged from 1.5 up to 130 micrograms per ml of potassium from 0.5 up to 5.0 micrograms per ml. The concentration of the other elements varied from 0.0001 up to 0.500 micrograms per ml.